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PILOT'S HANDBOOK

FOR THE

FLEXIBLE WING AERIAL UTILITY VEHICLE XV-8A

(RYAN MODEL 164)

Developed and Manufactured by

RYAN AERONAUTICAL CO.

This research was supported by the Advanced Research Projects Agency of the Department of Defense and was monitored by U. S. Army Transportation Research Command under Contract No. DA 44-177-AMC-874(T).

1 March 1964

DRAFT

Preliminary copy additional pilot data to be added

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FOREWORD

TO DERIVE MAXIMUM UTILITY FROM THE CONTENTS OF THIS HANDBOOK, IT IS IMPORTANT THAT THE PILOT READ THIS FOREWORD CAREFULLY.

This handbook contains information necessary for safe and efficient operation of the U.S. Army Flexible Wing Aerial Utility Vehicle (FLEEP) based on existing knowledge. Flight tests of the vehicle have not been completed; therefore, some information contained herein is calculated or may be projected from information obtained during preliminary test flights. In view of the foregoing, frequent revisions, additions, and deletions will be made to the contents of this handbook. It is extremely important that the pilots and others responsible for operations of the vehicle become completely familiar with the latest operational information, even though it may not be incorporated in this handbook. Such information, not presently contained in this handbook, may be found in Army technical directives or contractor flight test reports.

The instructions and recommendations contained in this handbook consider the operator to be a qualified fixed-wing aircraft pilot and do not include basic flight principles or training instructions within that framework. It is anticipated that the FLEEP will ultimately be simple enough to be flown by personnel with a very minimum of flight instruction and experience. END Until such time as the flight test program has been completed, it is recommended that only experienced fixed-wing pilots conduct

flights in the FLEEP. The relatively extensive and diversified flying experience of such pilots is recognized, and the contents of this handbook reflects that recognition.

This handbook, subdivided into major sections, the titles of which are self explanatory is similar to other handbooks with which pilots are familiar. This handbook cannot be improved unless the discrepancies of the information provided herein are made known by the pilots who fly the FLEEP.

It is important that the users understand the following definitions which apply to the words "WARNING," "CAUTION," and "NOTE" as used in this handbook:

WARNING:	Operating procedures, practices, etc., which will, if not closely and carefully followed, result in serious injury or loss of life.
CAUTION:	Operating procedures, practices, etc., which will, if not strictly observed, result in damage to equipment and/or the vehicle.
NOTE:	An operating procedure, condition, etc., which is worthy of emphasis.

SECTION I
DESCRIPTION

1.1 Description.

1.1.1 General. The U.S. Army Flexible Wing Aerial Utility Aircraft, figures 1, 2, and 3, is designed to carry out the functions of a light utility aircraft. The vehicle is essentially a self-propelled flying cargo platform supported from a Rogallo type flexible wing. A pilot's seat and the necessary flight controls are provided at the forward end of the platform. An engine, pusher propeller, and a "V" tail are mounted at the rear of the platform. Provision is made for manually folding the wing and tail surfaces.

1.1.2 Dimensions. The principal dimensions of the vehicle are:

Length	26 feet
Wing Span (spread)	33.4 feet
Width (wing folded)	10 feet
Height (wing at zero incidence)	14.5 feet
Wing Area (flat plan form)	450 square feet
Wing Sweep (leading edge)	50 degrees
Wing Keel Length	26.0 feet
Length of Platform (cargo area)	80 inches
Width of Platform	64 inches
Wheel Base	10.6 feet
Wheel Tread	9 feet
Propeller Diameter	7 feet

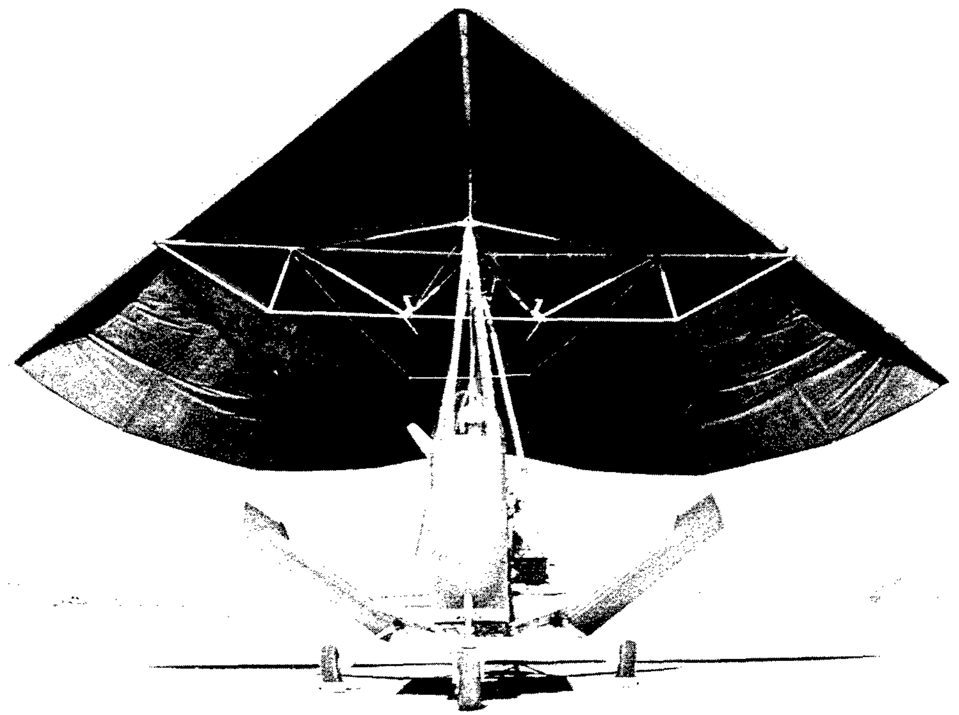


Figure 1. Flexible Wing Aerial Utility Vehicle, Front View

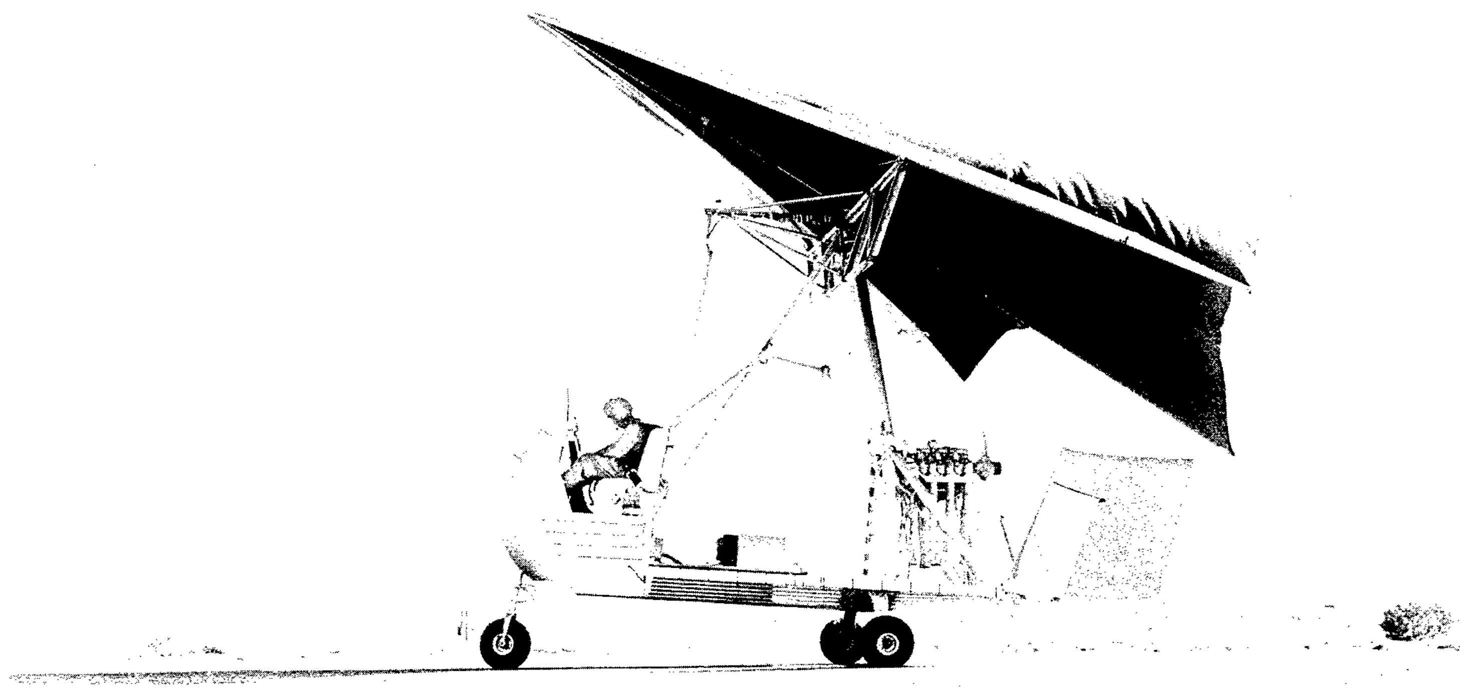


Figure 2. Flexible Wing Aerial Utility Vehicle, Side View

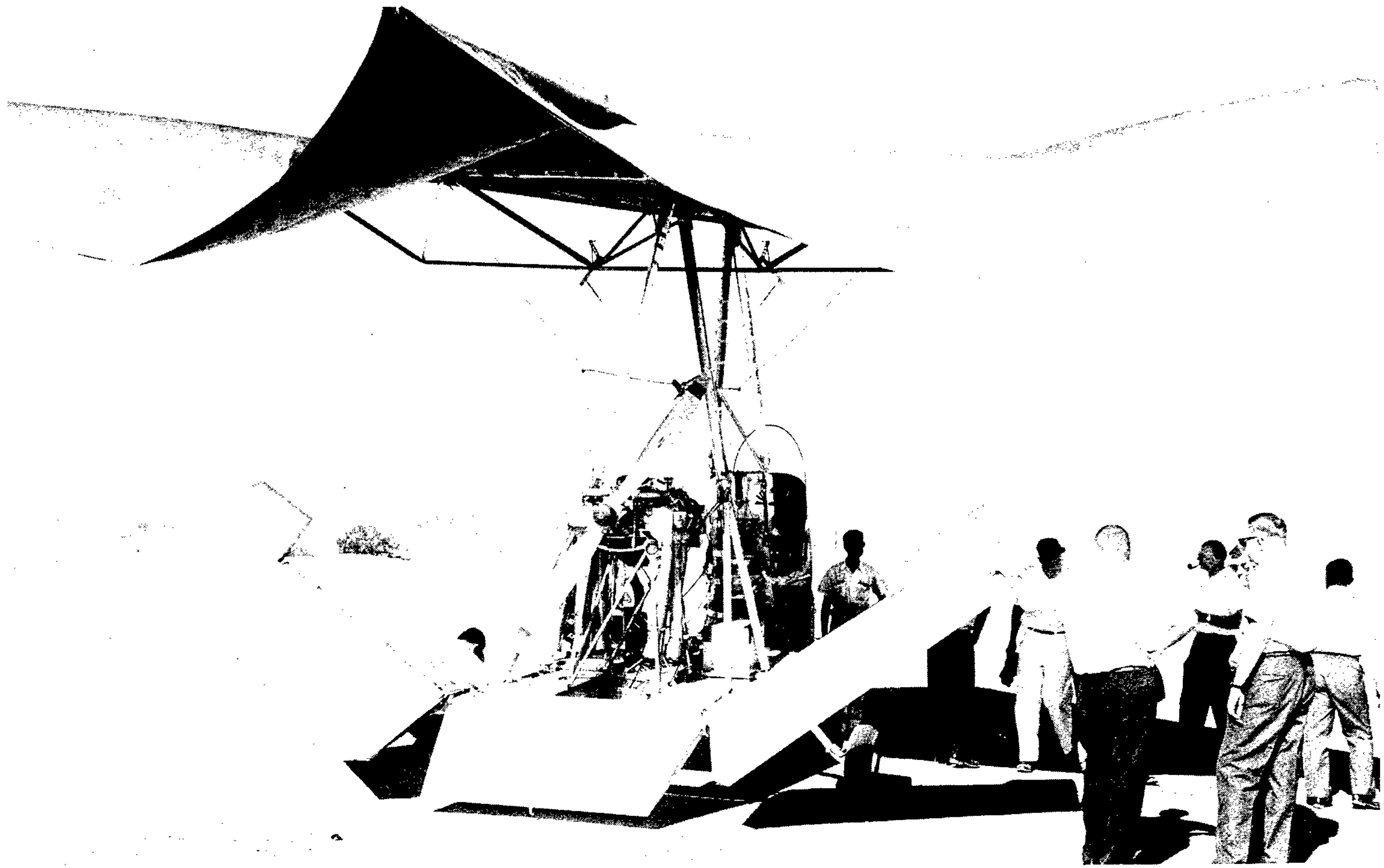


Figure 3. Flexible Wing Aerial Utility Vehicle, Rear View

1.1.3 Weights. The principal weights of the vehicle are:

Weight Empty	1,115 pounds
Engine Oil	15 pounds
Fuel	150 pounds
Pilot	170 pounds
Flying Weight Without Cargo	1,450 pounds
Cargo Payload	850 pounds
Design Gross Weight	2,300 pounds

1.2 Body.

1.2.1 General. The basic body structure is in the form of a flat deck. A raised platform at the forward end supports the pilot's seat, nose wheel, control mechanism, instrument panel, and nose fairing. Fittings on the pilot's seat back and at the sides of the platform attach the wing support struts. Other fittings at the aft end of the platform provide attachment for the engine mount truss and tail surfaces. The useable cargo area, 64 inches wide and 80 inches long, is fitted with twelve standard flush-type cargo tie-down rings. Because of the open-deck design, long slender cargo items may extend both forward and aft of the normal cargo area. Riveted aluminum alloy sheet and extruded sections are utilized in fabricating the platform structure.

1.2.2 Jacking pads are provided on the lower surface of the platform at the main landing gear and at the forward end of the cargo area. The forward end of the pilot's cockpit is a removable Fiberglas fairing. The fairing support framework also supports the instrument panel and the transparent plastic windshield. The pilot's seat, an integral part of the vehicle structure, is equipped with a standard seat belt and shoulder harness. Space has been provided to accommodate a back-pack type parachute.

1.3 Landing Gear.

1.3.1 General. The landing gear is of the tricycle type. The nose and main tires and wheels are the same size and type to minimize spare part requirements. The main landing gear tread is 9.0 feet, and the wheelbase is 10.63 feet. Large, low-pressure type III tires aid operation from soft ground or rough fields.

1.3.2 Main Landing Gear. Landing loads at the main wheels are absorbed by cantilever Fiberglas springs extending from both sides of the platform structure. Heat treated steel axles which mount the aluminum alloy wheels are bolted and clamped to the outboard ends of the springs. Single disc type hydraulic brakes incorporated in the main wheels are hydraulically actuated by a master cylinder in the pilot's cockpit. Pressurized hydraulic fluid is supplied to the brakes through flexible hoses encased in wire braid.

1.3.3 Nose Landing Gear. An oleo strut type shock absorber is incorporated in the nose landing gear. The nose landing gear assembly attaches to the forward end of the sheet metal platform by a tubular tripod type structure. The nose wheel which can be steered through an angle of 25 degrees either side of center by operating foot pedals in the pilot's cockpit produces a turning radius of 27.83 feet. The foot pedals are connected to arms extending from the sides of the shock absorber piston tube by a simple cable and pulley system. The nose wheel is aligned in a fore and aft position in flight by a centering cam.

1.4 Wing.

1.4.1 General. The wing is of the foldable flexible type made up of a rigid keel, two rigid leading edges, a rigid spreader bar, flexible membrane, fittings, and attaching hardware. The forward ends of the leading

edges attach to the forward end of the keel to form an apex which sweeps back at a 50 degree angle. The spreader bar which attaches to the keel at about midway, supports the leading edges to produce the proper sweep angle, and transmits the leading edge lift loads to the keel.

1.4.2 Wing Keel. The wing keel is a tapered sheet aluminum alloy box type structure. A fitting at its forward end supports the leading edge members. The keel attaches to the spreader bar by a hinge fitting at the keel 46 percent station. Fittings are provided forward and aft of the main hinge to attach the pitch trim control cables.

1.4.3 Wing Leading Edge. The leading edges are hollow aluminum alloy spars which have a symmetrical streamlined cross section, and taper from a maximum cross section near the spreader bar attachment toward both ends. An aluminum alloy channel at the maximum cross section serves as a shear web. The attachment at the spreader bar is a swivel fitting with one axis lying along a chord-line and the other axis forward of and parallel to the leading edge. The attachment at the keel is a spherical rod end type fitting. Since the spar is free to align itself to the load, and the wing membrane is attached along the trailing edge, membrane tension is always applied to the plane of maximum spar stiffness. The aft 13-1/2 percent of the leading edge is hinged to permit ±5 degree motion in a chordwise direction to provide additional lateral control. The hinge mechanism incorporates linkage to multiply the mechanical advantage of the actuating cable used to control the position of the hinged leading edge portion in flight.

1.4.4 Wing Spreader Bar. To hold the wing leading edges at their proper sweep angle and resist the effect of inward and upward forces on the membrane, a spreader bar truss work of steel and aluminum tubes is

attached to the keel and leading edges. The inboard portion of the truss, called the Roll Control Structure, also extends fore and aft between the front and rear wing support struts. The joints between the roll control structure and the wing support strut are hinged to permit the spreader bar truss and wing structure to roll about a horizontal fore and aft axis in response to forces from the roll control system. The outboard portions of the spreader bar are linked to the upper joint of the roll control structure just outboard of the roll axis. The lower chord members of the truss are joined to the roll control structure with quick release pins. By removing these pins, the spreader bar and the wing may be folded. Wing folding is a manual operation which can be performed by two men. The wing folds to a width of less than 8 feet.

1.4.5 Wing Membrane. The wing membrane fabric is square weave Dacron cloth coated on both sides with olive drab polyester resin. The coated material is flexible and extremely weather resistant. Total weight of the coated fabric is 8 ounces per square yard. The coated fabric has a tensile strength of not less than 200 pounds per inch in the warp direction, and not less than 120 pounds per inch in the fill direction. The membrane is attached along the keel and leading edges with machine screws. Metal reinforcing strips are bonded into the reinforced, bonded, and sewn edges of the membrane. To prevent trailing edge flutter, the aft edge of the membrane is scalloped, and thin wooden battens (3 per lobe) are retained in pockets sewn in the trailing edge membrane. A reinforcing cable, the length of which is adjustable on the ground for roll trim, is sewn into a hem along the aft edge of the membrane.

1.4.6 Wing Support Structure. A forward "A" frame and an aft tripod of aluminum alloy tubes attach the wing to the body structure. Sheet

metal fairings are used to streamline the tubes. The upper strut end fittings attach to the wing roll control structure at the roll control axis, which is parallel to the cargo deck.

1.5 Propulsion System.

1.5.1 General. The propulsion system, figure 4, consists of a six cylinder, aircraft reciprocating engine equipped with a fixed-pitch propeller employed as a pusher, and an exhaust-driven ejector cooling system.

1.5.2 Engine. The engine specifications are as follows:

Make and Model Number	- Continental IO-360A 6 Cyl. Horizontal Opposed Air Cooled 4.438 Bore; 3.875 Stroke, Wet Sump, Dual Magnetos
Displacement	- 360 cubic inches
Compression Ratio	- 8.5/1
Rated Maximum Continuous hp	- 195
Rated Maximum Takeoff hp	- 210
Recommended Maximum hp for Cruising	- 147
Maximum Crankshaft rpm Continuous	- 2800
Maximum Crankshaft rpm; Take-off	- 2800
Recommended Maximum rpm for Cruising	- 2500
Fuel Octane Rating	- 100/130 (Aviation Grade)
Fuel Control System	- Continuous Flow Injector
Starter	- None fitted

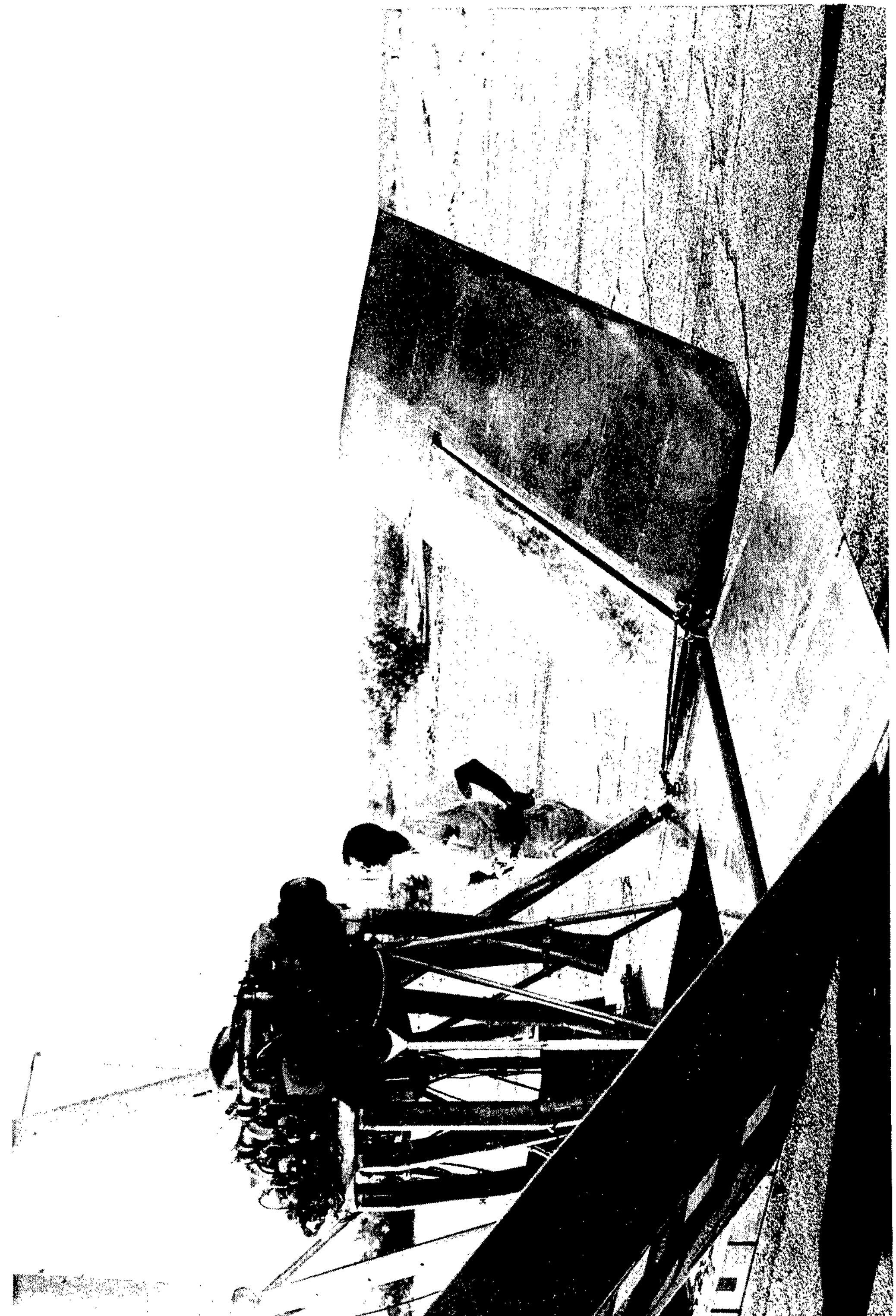


Figure 4. Propulsion System

Generator	- None fitted
Magnetos (Two)	- Scintilla S6LN-25
Spark Plugs (Twelve)	- Champion Type RH M38E

A steel tube truss supports the engine near the aft end of the platform structure. Four flexible rubber mounts are used to attach the engine to the truss. The propeller thrust line is inclined 3 degrees up at the rear with respect to the platform surface. The exhaust driven ejector cooling system is self-regulating, and requires no action on the part of the pilot. Sheet aluminum baffles direct the cooling air through cooling fins on the engine cylinders and heads. A scoop directs a free stream of air through the oil cooler which is rigidly mounted on the engine crank case. Oil flow through the cooler is regulated by a built-in thermostat device. The engine sump is designed to hold ten quarts of oil. Fuel is injected directly into the inlet ports of the individual cylinders by a continuous pressure metering system eliminating need for a carburetor and associated carburegor icing problem. Free-stream air is admitted to the induction system through an air maze type air filter. The filtering element is readily removable for cleaning.

1.5.3 Propeller. The Hartzell BHC-C2YF-1A all metal, seven feet in diameter propeller, installed is designed for automatic pitch regulation using an engine driven governor. However, since the small performance gain from pitch change on a slow speed aircraft does not justify the extra complexity, maintenance, weight, and cost, the propeller is operated at fixed pitch by locking the blades at the angle for best all-around performance.

1.6 <u>Tail.</u>

1.6.1 General. The vehicle is equipped with a Vee Tail (actually a U tail). The surfaces each comprise a fixed fin with horn balanced movable ruddervator surface attached. The tail dihedral angle is 35 degrees. The tail

surfaces are attached to the sides of the platform structure of its aft end. The attachment fittings are designed to permit the two tail portions to fold up and inboard for transportation or stowage. Folding is accomplished manually after removing a quick release pin at each fitting. Tie rings are provided at the tip of each rudder to secure the surfaces in the folded position. The ruddervator push-pull control rod has swiveling rod ends to permit folding without disconnecting the controls.

1.7 Fuel System.

1.7.1 General. A 25 gallon aluminum alloy fuel tank is mounted below the floor of the cargo platform near the center of gravity. The filler pipe extends forward and upward to a point on the left side of the cockpit below the pilot's seat. Vents are provided at both ends of the tank. The indicator of the float type fuel quantity gage is located at the forward end of the cargo deck where it is visible from the pilot's seat. The tank which is removable through a door on the bottom of the platform contains a drain plug at the bottom of the tank sump. Fuel from the tank flows through an emergency shut-off valve and a fuel strainer to an engine driven vane type pump mounted on a pad on the accessory end of the engine. This pump maintains a constant head of 8 psi at the inlet of the engine driven fuel metering pump. The fuel metering pump supplies fuel to the injection nozzles in the individual cylinder inlet ports at the pressure required for the particular throttle setting and engine speed. A gage on the pilot's instrument panel registers the fuel pressure at the injection nozzles which will vary between 8 and 17 psi under normal powered flight conditions. For starting, it is necessary to build up a pressure of at least 2-1/2 psi in the system using a hand pump mounted on the right hand side of the pilot's seat. A valve at the instrument panel may be turned to register

hand pump pressure instead of fuel injection pressure during starting. When set in the hand pump position with the engine running, the gage indicates the outlet pressure from the engine driven vane pump previously mentioned. The engine driven vane pump pressure may be checked occasionally by this means, to insure that it is operating properly. The emergency shut-off valve installed between the fuel tank and the fuel strainer performs two functions. In normal operation it can be closed to prevent excessive loss of fuel from the system while servicing the fuel strainer. In an emergency, the valve can be closed remotely by pulling the cable connected handle located within easy reach to the left of the pilot's seat. The fuel strainer incorporates a sump to retain water or foreign material, a drain valve, and a screen which may be readily removed for cleaning.

1.8 Control and Trim Systems.

1.8.1 General. For ease of operation by pilots with minimum training, the Aerial Utility Vehicle has been designed as a "two control" aircraft. Longitudinal control is accomplished by means of the tail surfaces described in paragraph 1.6.1, actuated by fore and aft motion of a control column in the pilot's cockpit, figure 5. Roll control results from displacing the wing about the roll axis. Roll is achieved partly by direct control force applied to the wing and partly by means of the movable tips of the wing leading edge, both actuated by the wheel at the top of the pilot's control column. To counteract the adverse yaw associated with wing roll, the control mechanism incorporates means to actuate the two ruddervators differentially when roll control is applied. To make the aircraft "stall proof" an adjustable stop is provided to limit the amount of up longitudinal control to prevent flying at wing angles of attack beyond 34 degrees,

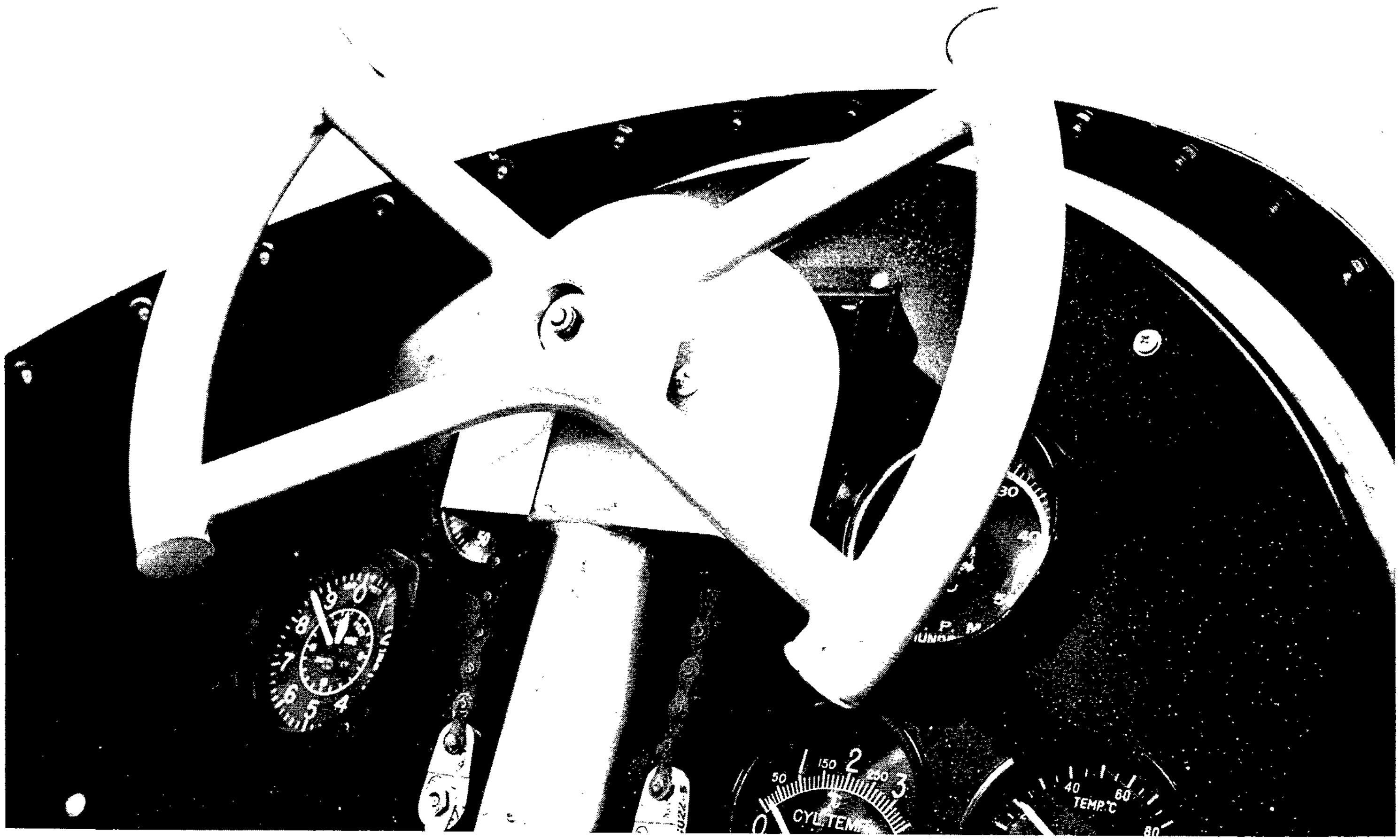


Figure 5. Pilot's Control Column

regardless of cg position. A pitch trim wheel on the left side of the pilot's cockpit, regulates the incidence of the wing to affect longitudinal trim for any flight speed and cg position within design limits. Right and left foot pedals for nose wheel steering and main wheel braking completes the cockpit control installation.

1.8.2 Longitudinal Control. A tubular steel control column is hinged to the floor of the pilot's cockpit. An arm on the bottom of the column extends below the floor, where it connects to the control interconnect mechanism. A cable and pulley system transmits motion from the interconnect mechanism to a bell crank near the aft end of the platform structure. The bell crank shaft extends upward through the floor and carries an arm which operates the ruddervator through a push-pull rod. The neutral position of the control column is 5 degrees forward of vertical. Full travel is ±19 degrees from the neutral position which corresponds to ±27 -1/2 degree at the ruddervator. A cable attached to the actuating arm below the floor and anchored to the forward end of the floor support structure limits the forward travel of the control column. The aft travel of the control column is limited by a cam and link mechanism which is actuated by the forward wing pitch trim cable. The purpose of the mechanism is to limit the control input to the amount necessary to fly the wing at a maximum angle of attach of 34 degrees and thus prevent the wing from stalling. In addition to the cam mechanism which automatically corrects for changes in wing pitch setting, a manual adjustment is provided to compensate for variations in cg location. The reasons for incorporating the variable control stop and the procedure for adjusting for various cg positions are contained in paragraph 1.8.5.

1.8.3 Roll Control. The wing roll axis, being parallel with the top of the cargo platform, lies essentially parallel to the line of flight. Wing motion about the roll axis therefore does not change the direction of free stream air over the wing. If the roll axis had been made parallel to the wing keel, roll displacement would introduce a yaw angle between the wing and the relative air. The aerodynamic effect of yaw on a Rogallo type wing is to produce a rolling moment. In this case the rolling moment would be in a direction to resist the control motion and restore the wing to its original attitude. The horizontal roll axis was incorporated to minimize the required pilot effort. To further reduce roll control forces, an aerodynamic boost system is incorporated. The boost system consists of hinged tip portions on the leading edge spars, which are differentially actuated by the initial movement of the control wheel. The effect is similar to that of spring tabs on ailerons on a conventional wing. The rolling moment due to tip displacement is in a direction to assist the desired wing roll. Further motion of the control wheel follows, or augments, the rolling motion of the wing, depending on the amount of force applied. Stop cables on the spreader bar structure limit wing roll to ±7 - 1/2 degrees. Control wheel motion is transmitted through a sprocket and chain to a cable system which is routed under the pilot's floor to the back of the seat, then up the center wing support strut to bell cranks located at the outboard extremities of the roll control structure described in paragraph 1.4.4. A cable from the upper arm of the left hand bell crank is routed across the spreader bar to the right hand leading edge, then aft to the right hand movable tip. The right hand bell crank is similarly connected to the left hand movable tip. Stops on the bell cranks limit the movable wing tip travel to ±5 degrees, which corresponds to 24 degrees of motion at the control wheel.

Any further motion of the control wheel produces rolling motion of the roll control structure by reaction of the bell crank against its stop. Total travel of the control wheel is ±90 degrees.

1.8.4 Directional Control. Differential motion of the tail surfaces is used to produce a yawing moment. Mechanism under the floor of the pilot's cockpit interconnects the roll control system with the directional control system to accomplish this result. The link between the lateral control system and the directional control system may be connected in any one of several gear ratios. The purpose of this arrangement is to permit varying amounts of yaw to roll control to be rigged into the system; the optimum value will be determined by flight test.

1.8.5 Longitudinal Trim. The vehicle may be trimmed longitudinally by operating the handwheel provided for that purpose on the left hand side of the pilot's seat. This wheel operates a cable drum through a set of reduction gears. Rotation of the drum reels cable off one side of the drum and on the other. The two cables are attached to the wing keel; one forward of the main pivot and one aft. Forward motion at the wheel rim produces a nose down moment and vice versa. An irreversible clutch in the wheel hub locks the wheel against rotation when torque is applied from the direction of the cable drum, but permits free rotation when torque is applied to the wheel rim. In flight at a given gross weight and cg position, wing incidence is set to cause the vehicle to trim at the desired flight speed. For the range of speeds and cg positions anticipated, wing incidence for trim will be between 18 degrees and 29 degrees. A marker on the pitch trim cable is visible through a window in the pitch trim housing at the side of the pilot's seat to indicate when the wing incidence is within the normal operating range. Five full turns of the trim wheel are required

to move the wing from 18 degrees to 29 degrees. Additional travel is provided to bring the wing to a lower incidence for convenience in folding. The geometry of the cable system is such that the cables become somewhat slack when the wing incidence is reduced below 16 degrees.

1.8.6 Roll Trim. A small diameter steel cable which passes through a hem in the trailing edge of each lobe of the wing canopy can be adjusted at the fitting that attaches the cable to the wing keel, while the vehicle is on the ground. Tightening the trailing edge cable increases the lift of that wing lobe, thus providing a means of trimming the vehicle in roll.

1.8.7 Yaw Trim. No provision is made for yaw trim.

1.8.8 Nose Wheel Steering and Brakes. Foot pedals in the pilot's cockpit are connected by cables to steering arms extending from each side of the nose wheel strut oleo piston tube. Pushing on the right hand pedal causes the wheel to steer to the right and vice versa. Stops at the pedals limit the steering motion to ±25 degrees. Minimum turning radius is 27.83 feet. Both rear wheel brakes are operated by applying foot pressure to a hydraulic master cylinder connected to an auxiliary pedal mounted on the right steering pedal.

1.8.9 Engine Controls. Engine throttle and fuel mixture controls are located at the left hand side of the pilot's cockpit on an extension of the structure that supports the instrument panel. The quadrants incorporate double acting friction locks to prevent creeping during flight. Connections from the control quadrants to the engine are made by push-pull rods encased in spiral wound flexible conduits. When moved to its extreme aft position, the mixture control handle operates the "idle cut-off" valve which shuts off the flow of fuel to the injection nozzles on the engine. The throttle operates in the conventional manner. The magneto switch is

mounted on the aft face of the structure that supports the engine control quadrants. Directly below it is a two position tachometer switch. Its purpose is to transmit magneto primary current to the electric tachometer. When checking magnetos during engine run-up, it is necessary to switch the tachometer to the appropriate magneto in order to indicate engine rpm while operating on a single magneto. When the ignition switch is turned to "Both," the tachometer switch may be at either position.

1.9 Instrumentation.

1.9.1 General. With the exception of the fuel quantity gage described in paragraph 1.7.1, all instruments are supported on the shock mounted pilot's instrument panel, figure 6, and at the forward end of the pilot's cockpit. Access to the back of the panel may be had by removing the Fiberglas nose cowl. Instruments pertaining to engine operation consist of an electric tachometer, an oil temperature gage, an oil pressure gage, a fuel pressure gage, and a cylinder head temperature gage. The cylinder head temperature gage indicates the temperature of the hottest running cylinder as determined by test. Flight instruments comprise an altimeter, a sensitive airspeed indicator, and a magnetic compass.

1.9.2 Engine Tachometer. The engine tachometer, figure 7, detail A, indicates the engine rpm and is graduated from 0 to 5000 rpm. The tachometer indicator is electrically driven by a tachometer transmitter which receives signals from the magnetos. A limit hand is adjusted by turning the knob in the center of the dial.

1.9.3 Combined Engine Gauge. The combined oil pressure, fuel pressure, and oil temperature gage, figure 7, detail B, consists of three instrument movements mounted within a single case. The oil temperature gage is a temperature bulb-bourdon tube type movement, and its dial is

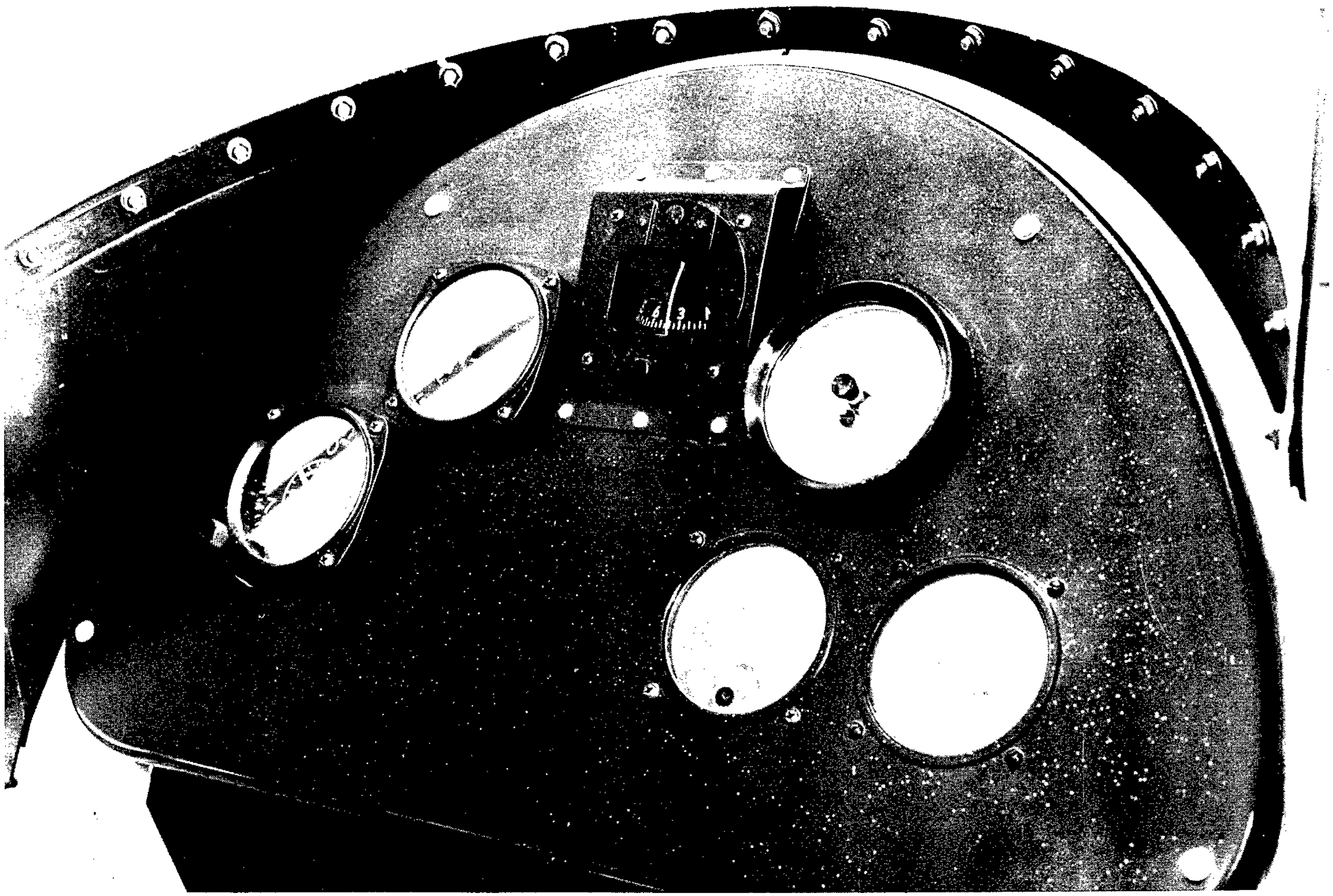


Figure 6. Pilot's Instrument Panel

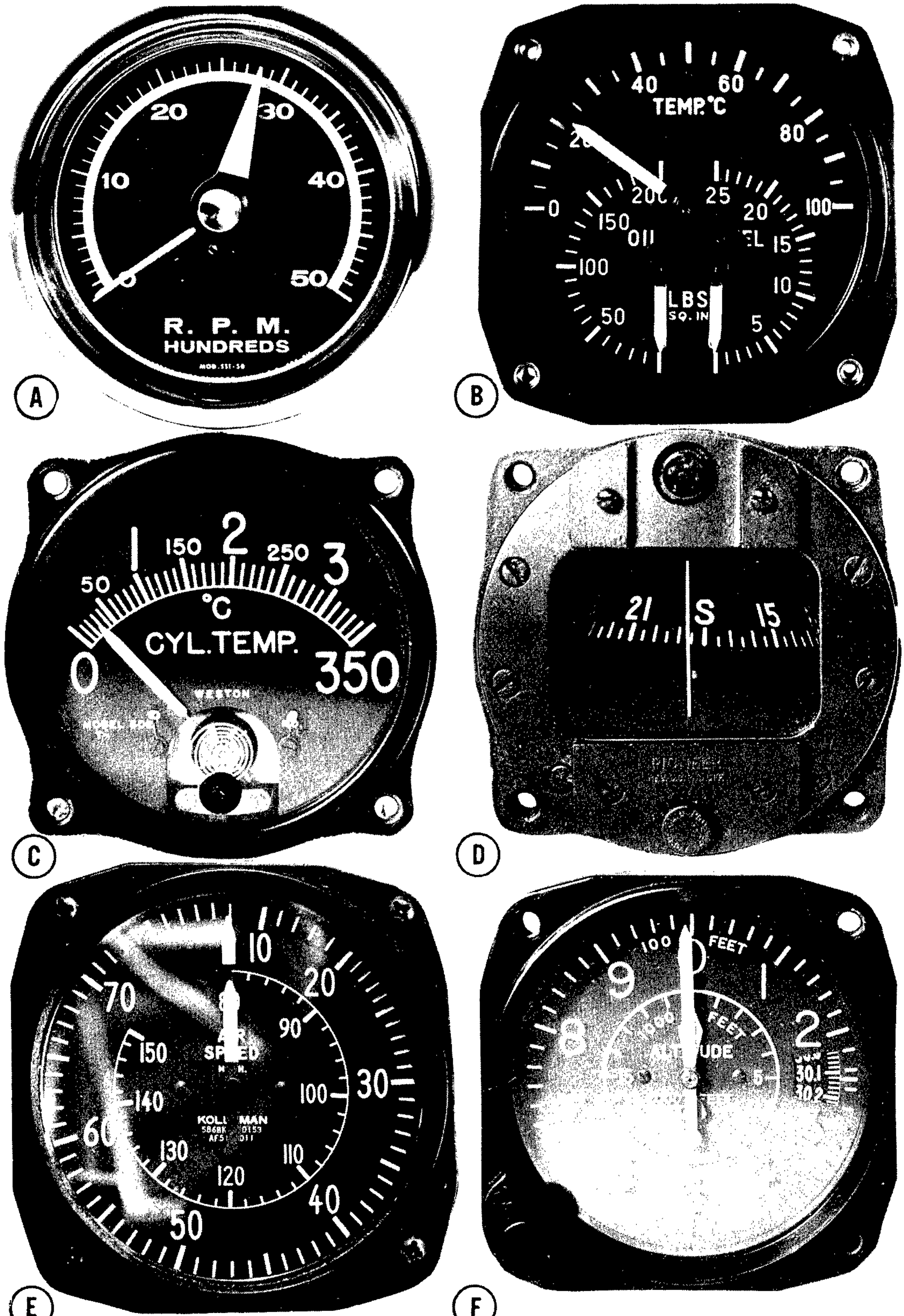


Figure 7. Instrument Details

calibrated from 0 to 100 degrees C. The oil pressure gage is a bourdon tube movement with a dial calibrated from 0 to 200 psi. The fuel pressure gage is a bourdon type movement with a dial calibrated from 0 to 25 psi.

1.9.4 Cylinder Head Temperature Gage. The cylinder head temperature gage, figure 7, detail C, uses a thermocouple to generate the temperature signal. The temperature indicator is calibrated from 0 to 350 degrees C. The thermocouple, in the form of a sparkplug gasket, is inserted under the sparkplug of the cylinder that normally runs hottest.

1.9.5 Flight Instruments. The magnetic compass, figure 7, detail D, airspeed indicator, figure 7, detail E, the altimeter, figure 7, detail F, (these instruments are the only flight instrumentation) are standard items. Except for barometric compensation of the altimeter, no flight instrument adjustments are required.

SECTION II

NORMAL PROCEDURES

2.1 Before Entering Cockpit.

2.1.1 Flight Restrictions. Refer to Section IV for flight limitations and restrictions imposed on the FLEEP.

2.1.2 Weight and Balance. Insure that Weight and cg Limitations, contained in Section IV, are not exceeded. Additional cg information will be supplied when available.

2.1.3 Exterior Inspection - Walk Around. A walk-around inspection of the following items shall be made prior to each mission:

Item	Action
Nose wheel tire	- Check for proper inflation (17 to 25 psi)
Oleo strut	- Check inflated (35 psi)
Pilot's windshield	- Check clean
Main wheel, right	- Wheel chock in place
Tire, right wheel	- Check for proper inflation (17 to 25 psi)
Pitot tube	- Clear, unobstructed
Propeller blades	- Check for foreign materials
Main wheel, left	- Wheel chock in place
Tire, left wheel	- Check for proper inflation (17 to 25 psi)
Gasoline filler cap	- Check in place

The information contained in this handbook is preliminary and validation by flight test is incomplete.

Item	Action
Fuel quantity indicator	- Check quantity
Cargo/Ballast	- Check for security WARNING Any significant shifting of cargo may place cg position beyond allowable limits.
Control linkages, cables and fittings	- Check for security, safety wire, and tautness
Engine	- Make sure no foreign material is stored against the engine, that all engine equipment is secure, and that there are no indications of oil or fuel leakage
Air Filter	- Check that filter is clear and clean
Throttle and Mixture Controls	- Operate throttle control and mixture control through normal full range and check for binding and slippage. - Leave mixture control in the IDLE CUT OFF position
Propeller	- Check security and turn propeller over several times by hand with the ignition switch in the OFF position to clear cylinders
Wheel Chocks	- Check that chocks are in place and secure

The information contained in this handbook is preliminary and validation by flight test is incomplete.

2.2 <u>On Entering Cockpit.</u>

2.2.1 Interior Check. The pilot shall make the following interior check prior to each flight:

a. Safety Belt fastened

b. Ignition Switch OFF

c. Fuel Selector Valve OFF

d. Mixture and Throttle Control OFF

e. Trim within limits

f. Fuel Quantity at level indicator

2.3 <u>Before Starting Engine.</u>

2.3.1 Prepare to start the engine as follows:

a. Insure that the fuel shutoff valve is in the OPEN (down) position.

b. Insure that the fuel pressure selector switch is in the normal running position.

2.4 <u>Starting Engine.</u>

2.4.1 Start the engine as follows:

a. Set the mixture control to the FULL RICH position.

b. Advance the throttle control to approximately the 1/8 to 1/4 inch position.

c. Rotate the propeller by hand to loosen congealed oil surfaces and clear cylinders.

WARNING

<u>Always stand clear while turning the propeller. When the engine is hot, or when the ignition switch is in the BOTH, RIGHT, or LEFT position, the propeller may kick or the engine may start, causing injury to personnel.</u>

d. Pump wobble pump until fuel drips from fuel injector overflow lines on the engine.

e. Turn the ignition switch to the BOTH (magnetos) position.

f. Signal the ground crew to crank the engine with the propeller.

g. If the engine fails to start, after several attempts, turn the ignition switch to OFF, place the throttle in the full open position, and turn the engine over several times with the propeller to clear the cylinders.

h. Repeat steps b, d, e, and f.

i. After the engine is started, adjust the throttle to idling rpm (900 to 1000).

NOTE

If the engine indicates it may stop at idling speed, pump the wobble pump a few strokes.

2.5 Engine Ground Operation.

2.5.1 Engine Warm Up. After it has started, warm up the engine as follows:

a. Make sure the engine oil pressure is within limits.

b. Warm up engine at 900 to 1000 rpm for at least one minute followed by additional warm up at 1200 rpm.

CAUTION

Do not run engine at run up speed (1700 rpm) unless oil temperature is 75 degrees Fahrenheit.

2.5.2 Ground Test. Run engine up to 1700 rpm and perform the following checks:

The information contained in this handbook is preliminary and validation by flight test is incomplete.

a. Move magneto switch and tachometer switch to "R" position and note engine rpm.

b. Move magneto switch and tachometer switch to "BOTH," then to "L" position. Maximum rpm drop in the "L" and "R" position should not exceed 125 rpm nor should there be greater than 50 rpm difference between rpm at "L" and "R" positions.

c. Return magneto switch to "BOTH" position.

d. Slowly and smoothly increase throttle to wide open and check for rpm approaching maximum and smooth running of the engine.

e. Check oil pressure between 30 and 60 psi.

f. Return throttle to idle.

2.6 Checks Before Taxi.

2.6.1 The following control checks must be made before taxiing the Flexible Wing Aerial Utility Vehicle:

a. Brakes - Depress the brake pedal. If the brake pedal can be depressed more than half stroke, or if the pedal is spongy, the brakes must be serviced; refer to the maintenance package.

b. Steering - Depress the steering pedals one at a time and note that the nosewheel turns about 25 degrees to the side of the depressed pedal.

c. Roll Control - Turn the pilot's control wheel hard right (90 degrees) and check response. The right and left movable wing tips should respond to the limit of their stops (5 degrees) in the first 24 degrees of rotation. The wing should rotate on its axis during the remainder of the control wheel rotation. A similar but opposite response should be noted when rotating the control wheel hard left.

d. Pitch Control - Move the control column forward and aft through its arc of operation and note the response of the ruddervators.

e. Instrument Check - Check operation of the instruments, and adjust the altimeter to compensate for the local barometer reading.

2.7 Taxi.

2.7.1 Taxi speeds should be relatively slow, especially where cross winds are greater than 5 - 8 knots. In order to reduce "heeling" tendencies in cross winds, apply lateral control into the wind. This may best be accomplished by leading the anticipated cross wind with wheel control such that the wing is tilted into the wind before the cross wind is actually encountered. Failure to follow this procedure may cause the wing to be picked up by the wind with subsequent excessive heeling of the entire vehicle. Little more than normal idle rpm should be required to start the vehicle moving and maintain a satisfactory taxi speed.

2.8 Before Takeoff.

2.8.1 Preflight Engine Check. The pilot shall make the following engine checks before each flight:

a. Insure that all engine instruments are within the recommended limits - "in the green."

b. Smoothly but rapidly apply full throttle. Observe that the engine accelerates to maximum power with no indications of missing or roughness. Recheck rpm to insure maximum power output. Rpm should be within 150 of maximum 2800 rpm.

c. In ground level high ambient temperature conditions small fuel pressure fluctuations due to vapor in the system, may be apparent. These fluctuations can be eliminated by a few strokes of the wobble pump.

2.8.2 Preflight Vehicle Check. The pilot shall make the following vehicle checks before each flight:

a. Check that longitudinal trim is properly positioned.

WARNING

Should trim control be adjusted to a setting, excessively displaced from takeoff position, longitudinal control may be inadequate for proper control as maximum longitudinal control positions are dictated by trim position. See figure 8 for takeoff trim positions.

b. Set the longitudinal control stop to the appropriate position for the existing cg location; see figure 9.

WARNING

Large deviations in the longitudinal control stop setting from that required may cause severe longitudinal control restrictions.

c. Apply full wheel deflection in each direction to insure that movable wing tips and wing are responding as required.

2.9 Takeoff.

2.9.1 The Flexible Wing Aerial Utility Vehicle is designed to take off from semiprepared or rough fields in short distances. To calculate the approximate takeoff distance required for a given gross weight loading, see figure 10. To take off, proceed as follows:

a. Set the brakes.

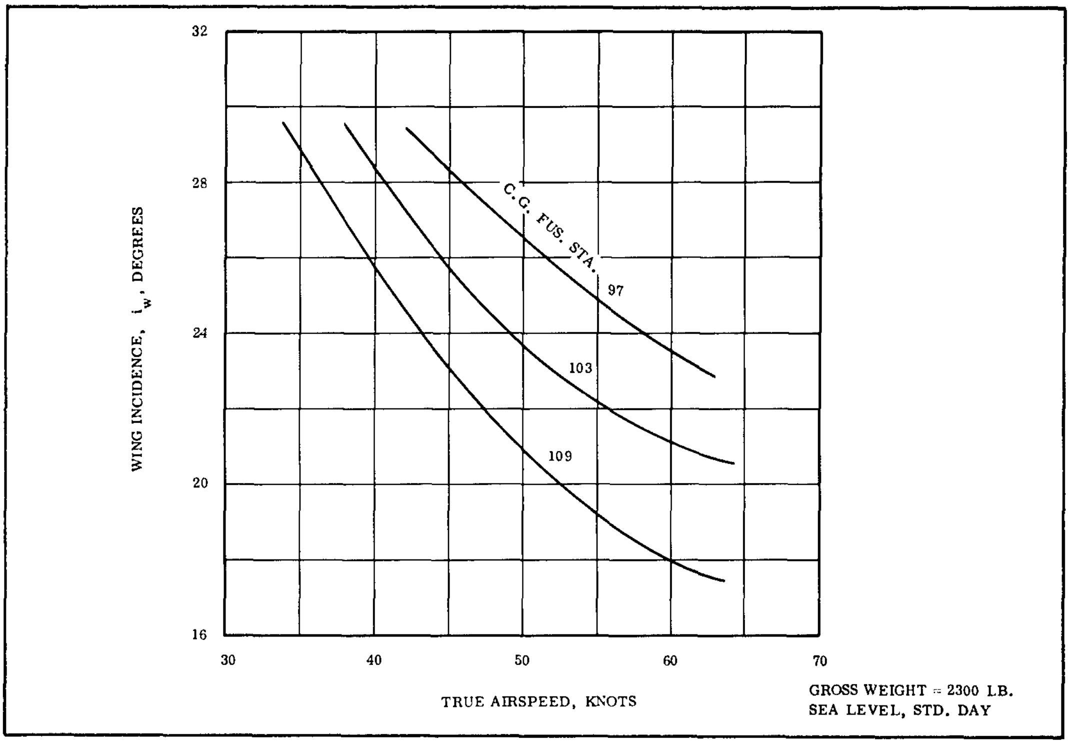


Figure 8. Wing Incidence Angles for Takeoff Conditions, Maximum Power

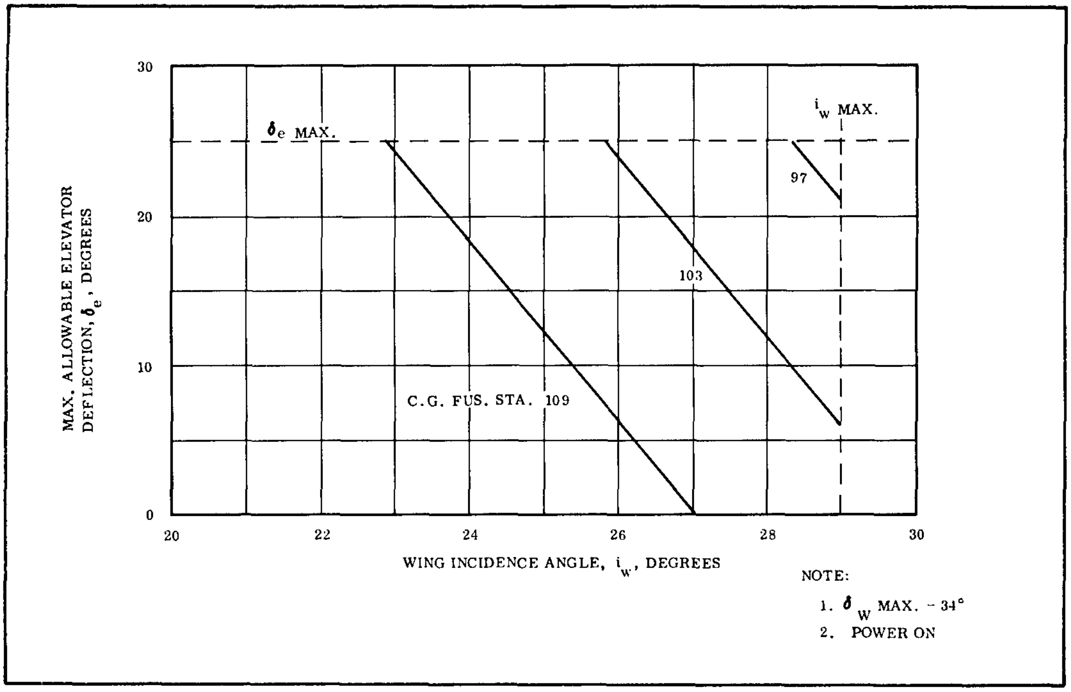


Figure 9. Elevator Stop Settings for Given Centers of Gravity

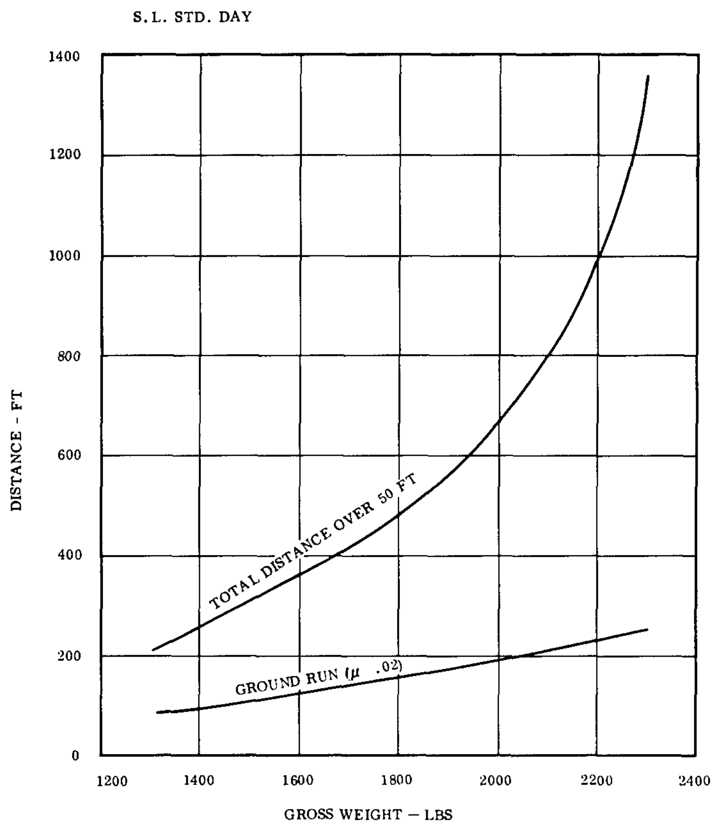


Figure 10. Takeoff Ground Run vs. Gross Weight

b. Check the fuel mixture control at RICH and increase the engine rpm to maximum.

c. Release the foot brakes and commence takeoff using nose wheel steering to maintain a straight ground run. Aircraft will fly itself off, with little or no aircraft rotation involved.

d. Use the pitch trim handwheel to trim to 45 knots climb airspeed.

e. Reduce power and fuel mixture to that consistent with the desired climb speed. Trim speed as required.

f. In takeoffs in cross wind, use lateral control to lower windward wing leading edge into wind to prevent heeling and drift, maintain heading by means of nose wheel steering.

2.10 Climb.

2.10.1 Following takeoff, power may be held at the maximum of 2800 rpm for maximum climb performance. With a wing trim setting of 24.5 degrees incidence angle and an indicated air speed of 45-50 mph IAS the vehicle is in good balance as very little aft stick force is required. The climb flight path is relatively steep under light to moderate gross weight conditions (up to 1900 pounds).

2.11 Descent to Landing.

2.11.1 Recommended speed during approach to landing is 45-47 mph IAS with the minimum of 42 mph IAS for 1900 pounds gross weight. To provide a flight path angle which is not too steep for a comfortable flare to landing touchdown, approximately 2100 rpm should be maintained during the glide.

2.12 Landing.

2.12.1 Landing is best accomplished by accurately adjusting the flare maneuver to arrive at the bottom of the flare one to two feet above the

runway surface and reducing power slowly to idle. If the flare maneuver is executed too high, with the power setting for glide (2100 rpm), the airspeed will fall below that required for minimum longitudinal control (approximately 37 mph IAS) and the sink rate will be too great for a satisfactory landing. In such a case power should be EASED ON to control the descent rate to touch down.

2.13 Touch-and-Go-Landings.

2.13.1 These data will be provided when available.

2.14 After Landing.

2.14.1 Following touchdown the vehicle may be decelerated in a very short distance by applying brakes until wheel skid is felt. There is no tendency for the vehicle to diverge in direction if the nose wheel is centered prior to its contact with the ground. Once all wheels are firmly on the surface excellent control for roll out and taxi exists.

2.15 Engine Shutdown.

2.15.1 Shut down the engine after taxiing to the parking area as follows:

a. Place the throttle control to IDLE.

b. Place the mixture control to IDLE cutoff.

c. Turn the ignition switch to OFF.

SECTION III

EMERGENCY PROCEDURES

3.1 Engine Failure During Takeoff.

3.1.1 If engine failure occurs during takeoff, and the vehicle is not airborne, abort the takeoff. Turn the ignition switch to the OFF position, reduce the ground speed as required by intermittent application of the brakes. (Procedures for engine failure during takeoff after the vehicle is airborne will be furnished when determined.)

3.2 Engine Failure During Flight.

3.2.1 If engine failure occurs during flight, apply forward stick to prevent loss of airspeed and establish a 45 knot glide. Retrim aircraft if enough altitude is available, see figures 11 and 12. Establish a 55 knot final approach speed to provide sufficient energy for flare to touchdown. If no suitable landing area is within reach, the decision to bail out should be made at no less than 750 feet altitude.

WARNING

Turn the ignition switch to OFF, and if possible, maneuver the craft so you will have a reasonably clear landing area with approach and landing into the wind.

3.3 Engine Fire.

3.3.1 The probability of engine fire is greatest when starting or stopping the engine. Ground crews should always stand by with hand CO_2 fire

To be provided when determined from Flight Test Data

Figure 11. Minimum Retrim Altitude After Engine Failure

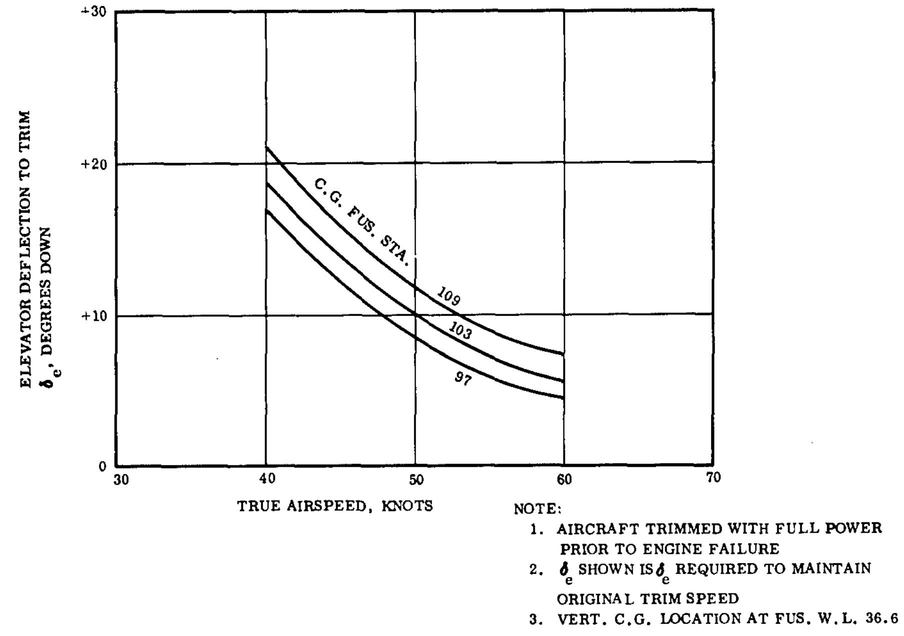


Figure 12. Engine Failure Retrim Elevator Deflection

extinguishers when starting or stopping the engine. If an engine fire is detected in flight, land immediately or bail out. No fire extinguishing equipment is installed in the Flexible Wing Aerial Utility Vehicle.

3.4 <u>Tire Failure.</u>

3.4.1 If a tire fails on takeoff and the vehicle is airborne, attempt a normal landing on the side of the runway opposite the blown tire. Brake the vehicle lightly and intermittently as required. Hard braking will tend to flip the vehicle. If a tire fails while landing, roll in lateral control opposite to the blown tire and attempt to maintain a straight roll out with nose wheel steering.

The information contained in this handbook is preliminary and validation by flight test is incomplete.

3.5 Bailout.

3.5.1 If fire or materials failure make the vehicle untenable and landing is impractical, bail out. If the emergency and altitude are such that time is available, the pilot should maneuver to an area where he has a reasonably clear and level area to land, and where the vehicle will cause a minimum of damage. The pilot must, in any case, bail out before reaching 750 foot altitude, and must go over the right side, preferably from a moderately banked right turn.

SECTION IV

OPERATING LIMITATIONS

4.1 Instrument Markings.

4.1.1 The instruments installed in the Flexible Wing Aerial Utility Vehicle, except for the fuel quantity indicator, are standard instruments not specifically designed for this application. Range and limit markings are incorporated on the glass face of the instruments except for the fixed range marks on the engine lubrication oil pressure gage. See figure 13 for instrument dial details and calibrations.

4.2 Engine Limitations.

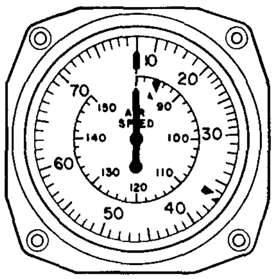
4.2.1 The engine is limited to operations that do not exceed 210 horsepower at 2800 rpm. Following are the recommended normal and maximum engine instrument readings:

Tachometer	
Maximum takeoff rpm	- 2800
Maximum continuous rpm	- 2800
Recommended cruising rpm	- 2500
Recommended idling rpm	- 600
Lube Oil Temperature	
Normal	- 75 to 170 degrees F (24 to 71.1 degrees C)
Maximum	- 225 degrees F (107.2 degrees C) using SAE 50 lubricating oil

The information contained in this handbook is preliminary and validation by flight test is incomplete.

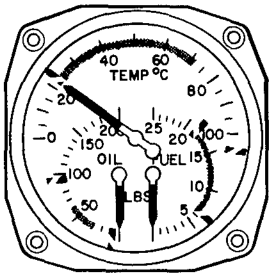
INSTRUMENT MARKINGS

AIRSPEED



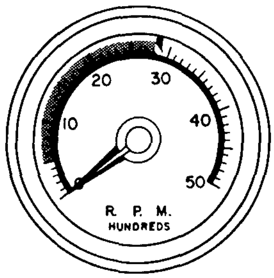
- 37 KTS - MINIMUM FOR FLIGHT
- 84 KTS - MAXIMUM FOR FLIGHT

ENGINE GAGE



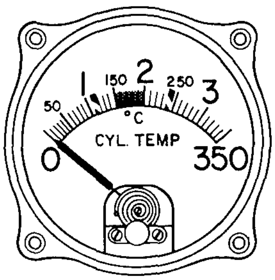
	OIL TEMP	OIL	FUEL	
(red marker)	24°C	10 PSI	7 PSI	MIN. FOR FLIGHT
(red marker)	107° C	90 PSI	18 PSI	MAX.
(shaded band)	24 - 71° C	30-60 PSI	7-18 PSI	NORMAL OPERATING RANGE

TACHOMETER



- 2800 RPM - MAXIMUM
- 500 - 2800 RPM CONTINUOUS OPERATION
- 2500 RPM - RECOMMENDED CRUISE RPM

CYLINDER HEAD TEMP.



- 120° C MINIMUM FOR FLIGHT
- 238° C MAXIMUM
- 150-200 NORMAL OPERATING RANGE

Figure 13. Instrument Operating Limit Markings

Lubricating Oil Pressure	
Normal	- 30 to 60 psi
Minimum	- 10 psi
Fuel Oil Pressure	
Wobble pump	- 8 psi
Injector pump	- 7 psi minimum
Cylinder Head Temperature	
Maximum Hottest Cylinder	- 460 degrees F (237.7 degrees C)

4.3 Overspeed Limitations.

4.3.1 The maximum engine speed of 2800 rpm shall not be exceeded. The recommended engine cruising speed of 2500 rpm should be exceeded only for takeoff and such other operations when power instead of fuel economy is the primary consideration.

4.4 Maneuvering Limitations.

4.4.1 These data will be provided when available.

4.5 Acceleration Limitations.

4.5.1 Designed acceleration limitations are:

0.5 g to 1.5 g normal acceleration

4.0 g landing load factor

Further data will be provided when available.

4.6 Weight Limitations.

4.6.1 The designed weight of the Model 164 Flexible Wing Aerial Utility Vehicle is 1115 pounds dry and empty. The designed gross weight, including fuel, lubricating oil, pilot, pilot equipment, and cargo is 2300

pounds which must not be exceeded. A payload of 850 pounds in addition to the weight of an equipped pilot weighing 170 pounds is permissible.

4.7 Center of Gravity Limitations.

4.7.1 The nominal center of gravity is at fuselage station 103.00; forward limit is at fuselage station 97.00; aft limit is at fuselage station 109.00.

SECTION V

FLIGHT CHARACTERISTICS

5.1 Scope.

5.1.1 This section contains information based on the preliminary design flight characteristics and the incomplete flight test program of the Flexible Wing Aerial Utility Vehicle. Use extreme care when operating the vehicle based on this information until it is validated as a result of information obtained during actual flight tests.

5.2 Stall.

5.2.1 The designed stall speed of the Flexible Wing Aerial Utility Vehicle at full load conditions of 2300 pounds gross weight is 34.4 knots (sea level standard day). To calculate the stall speed at other than full load conditions see figure 14.

5.3 Spins.

5.3.1 Although preliminary flight tests have shown the Rogallo wing to have inherent directional stability, it is not unlikely that some control configuration combinations may start the vehicle into a spin. The pilot must be particularly alert to detect any unstable condition near the stall so he can take early, positive preventive action to avoid entry into a spin as recovery characteristics are unknown at this time.

5.4 Spin Recovery

5.4.1 These data will be provided when available. However, should the pilot for some reason find himself in a spin, he should apply full forward longitudinal control and trim, and roll the wheel full against the spin.

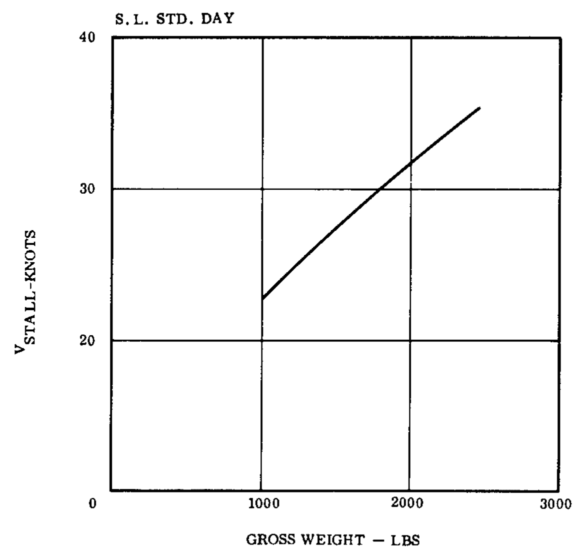


Figure 14. Stall Speed vs. Gross Weight

When rotational velocity starts to slow he shall begin returning wheel to neutral in roll, reaching neutral as rotational velocity reaches zero. Retrim aircraft longitudinally.

5.5 Flight Controls.

5.5.1 General. The flight control system of the Flexible Wing Aerial Utility Vehicle is a two-control system. A 14-inch diameter control handwheel rotates 90 degrees to the right or left of center for roll control and integrated directional control. The control column moves forward and aft for pitch control. Pedals are provided for nosewheel steering.

NOTE

Means are available for changing the flight control system to a conventional three control system in a simple and rapid manner if desired.

The information contained in this handbook is preliminary and validation by flight test is incomplete.

5.5.2 Roll Control. Turning the control wheel through its first 24 degrees actuates the hinged tips of the wing leading edges (wing tips). The wing tips deflect differentially in the direction required, to the limit stops which are set to limit movement to ±5 degrees. The remaining 66 degrees of control wheel rotation cause the wing assembly to rotate about its axis in the direction required to the maximum rotation of 7-1/2 degrees. The cable system that actuates the wing is interconnected to the tail control surfaces to cause them to deflect differentially to coordinate the turn.

5.5.3 Pitch Control. Forward and aft movement of the column through its control arc actuates the cables which deflect the tail surfaces collectively. Forward motion reduces the aircraft pitch attitude and aft motion increases the pitch attitude.

5.6 <u>Level Flight Characteristics During Various Speed Conditions.</u>

5.6.1 The trim wing-incidence settings (for cruising and power off condition) are presented in figures 15 and 16 as a function of velocity and power for three center of gravity (cg) locations. After attaining the desired cruise altitude and speed, use the pitch trim handwheel to trim to a zero stick force.

5.7 <u>Maneuvering Flight.</u>

5.7.1 These data will be provided when available.

5.8 <u>Diving.</u>

5.8.1 These data will be provided when available.

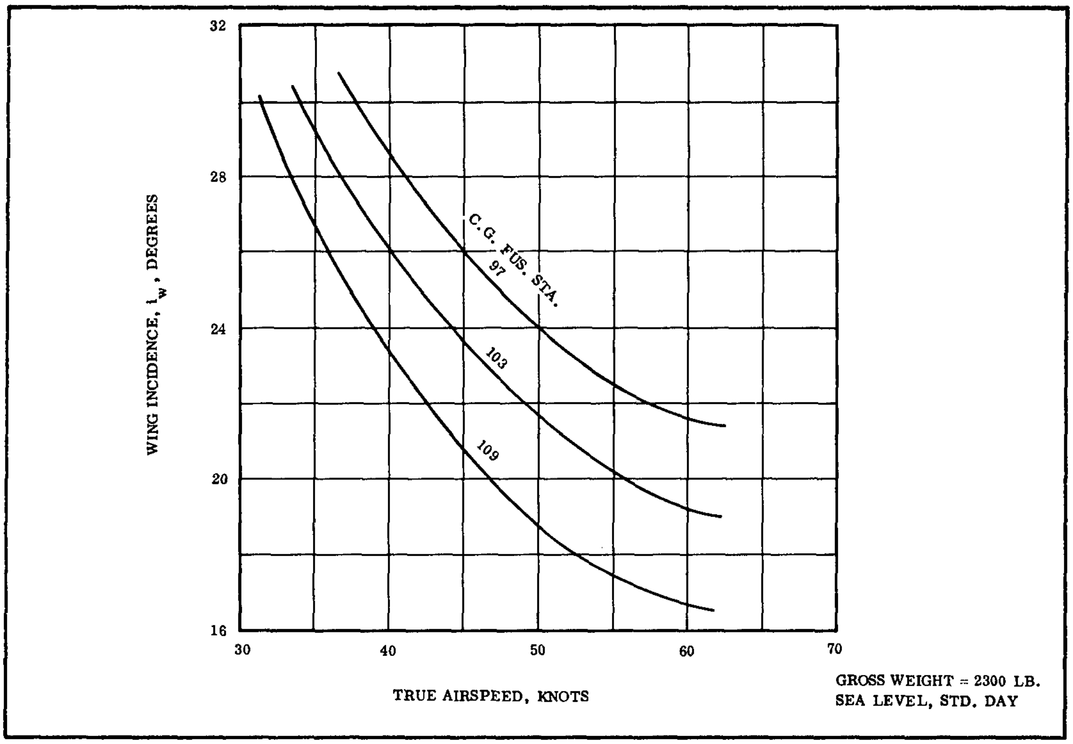


Figure 15. Flight Characteristics, Level Flight, Cruising Power

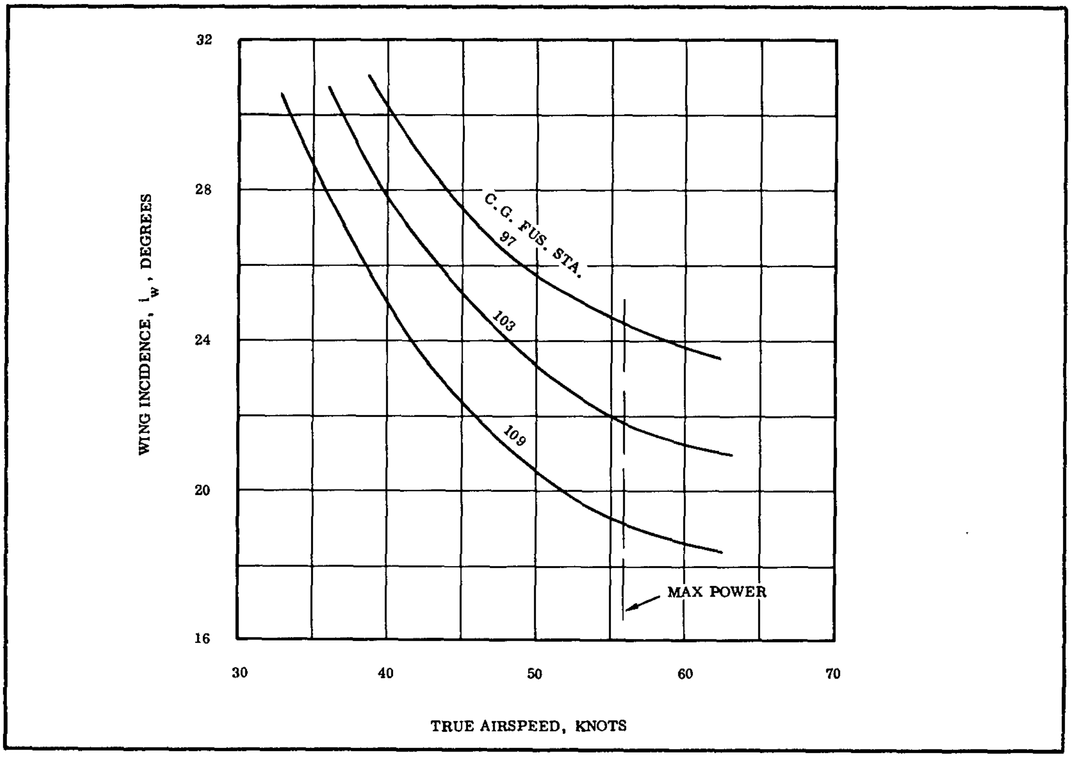


Figure 16. Flight Characteristics, Level Flight, Power Off

DEPARTMENT of DEFENSE

Directorate for Freedom of Information and
Security Review, Room 2C757
1155 Defense Pentagon
Washington, DC 20301-1155

Facsimile Transmittal

30 November 2001

To: **Mr. Larry Downing**

Organization: DTIC
Office Phone:
FAX Number: (703) 767-9244

From: **Sharon Reinke, Navy Division, DFOISR/WHS/DOD**

Phone: (703) 697-2716
FAX: (703) 693-7341

Total Pages Transmitted (including cover sheet): 04

Comments: I am forwarding the FOIA request DTIC received, the DTIC forwarding letter, and a list of documents. The documents in the attached list have been released to a FOIA requester [under our case number 01-F-2458] and are, therefore, cleared for public release. If you have questions, give me a call.

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April 11, 2001

Defense Technical Information Center
Attn: Kelly Akers, FOIA Manager
8725 John J. Kingman Road Suite 0944
Fort Belvoir, VA 22060-6218

FOIA REQUEST

Dear Ms. Akers:

American Lawyer Media respectfully requests, under the Freedom of Information Act, a copy of each of the following records:

AD B253477, XV-8A Flexible Wing Aerial Utility Vehicle, by H. Kredit, January 1964, 144 pages

AD B252433, Pilot's Handbook for the Flexible Wing Aerial Utility Vehicle XV-8A, March 1964, 52 pp

AD B200629, Flex Wing Fabrication and Static Pressure Testing, by Larry D. Lucas. June 1995, 80 pages

AD B198352, Materials Analysis of Foreign Produced Flex Wings, by Albert Ingram, march 1995, 16 pp.

AD B131204, Active Flexible Wing Technology, by Gerald D. Miller, Feb. 1988, 256 pages

AD B130217, Producibility Analysis of the Alternative Antitank Airframe Configuration Flex Wing, June 1988, 112 pages

AD B126450, From Delta Glider to Airplane, June 1988, 5 pages

—AD ~~B~~803668, Sailwing Wind Tunnel Test Porgram, September 1966, 125 pages

AD 477 482, An Evaluation of Flex-Wing Aircraft in Support of Indigenous Forces Involved in Counterinsurgency Operations by R.A. Wise, Feb 1965, 74 pages

—AD 461202, XV-8A Flexible Wing Aerial Utility Vehicle, H. Kredit, Feb. 1965, 100 pages

—AD 460405, XV-8A Flexible Wing Aerial Utility Vehicle, Final Report, Feb. 1965, 113 pages

—AD 431128, Operational Demonstration and Evaluation of the Flexible Wing Precision Drop Glider in Thailand, by William R. Quinn, November 1963, 22 pages.

AD 430150, Comparative Evaluation of Republic Bikini Drone System, Final Report, 1943?

We agree to pay up to $200 for costs associated with this request. We are grateful for your kind assistance in this matter. Please contact me at 212-313-9067 if you have any questions relating to our request.

Sincerely,

Michael Ravnitzky
Editor

Encl 11